

# UML Shuttle

A PUBLICATION OF THE UNIVERSITY OF MASSACHUSETTS LOWELL

## DARPA Funds Bold Research on Limb Regeneration

### Researchers Put Heads Together to Grow an Arm and a Leg

**P**rofs. Susan Brauhn and Kenneth Marx have teamed up to pursue a “mind-blowing” innovation—to cause a limb to re-grow in an adult mammal.

The UMass Lowell research group has joined groups from five other institutions and secured funding from the Defense Advanced Research Projects Agency (DARPA). The UMass Lowell portion of the DARPA grant is \$1.2 million for the first two years, with an anticipated continuation of \$1.4 million for the next two years.

The research groups expect that by working together they will gain a more complete understanding of the cellular and molecular processes that allow cer-

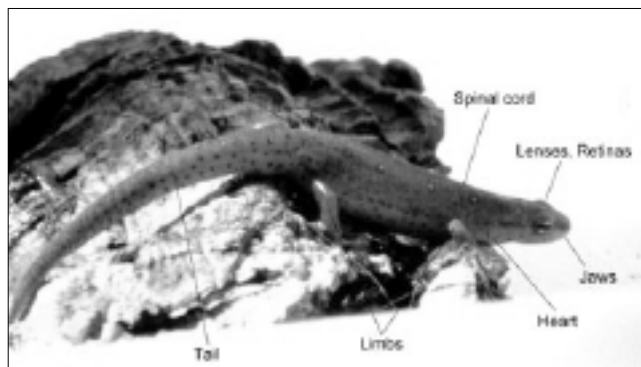
tain creatures, such as salamanders, to completely regenerate lost limbs, and be able to harness this capacity in mammals.

“As a consortium, we’re putting together our knowledge of stem cells, tissue development and healing, extracellular matrix, growth factors and the regulation of gene expression,” says Brauhn. “We’re encouraged by research results and recent discoveries and we believe this goal is attainable.”

The implications of such research are especially evident considering the wounded soldiers returning from Afghanistan and Iraq include twice the number of amputees of previous conflicts and wars.

Brauhn and Marx had already taken great strides in understanding the role of the cell scaffolding, or extracellular matrix, in healing—work that has been spun off into a commercial wound-healing application, the Smart Bandage. Now they will be working on understanding how the matrix--

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▲ One form of newt, the Eastern or red-spotted newt—capable of limb regeneration, will be studied. (Photo courtesy of Dr. Shannon Odelberg)

## First Company Joins Mass Medical Device Development Center

### Perfusion Technology Will Relocate to Wannalancit

**J**ust as the *Star Wars* movies’ Queen Amidallah turned to the fix-it droid R2D2 when she ran into mechanical difficulties, Perfusion Technology of Lawrence has turned to M2D2—the Massachusetts Medical Device Development Center—for help with its technical problems.

M2D2 was launched last year with \$135,000 in seed funding, awarded to Prof. Stephen McCarthy of Plastics Engineering by UMass President Jack M. Wilson. The Center aims to combine the engineering expertise at UML, the clinical and medical expertise at UMass Worcester, and the marketing expertise of the Donahue Institute, a research arm of the UMass President’s Office. It is co-directed by McCarthy and Prof. Sheila Noone, director of the Office of Clinical Research at UMass Medical.

“For the past two years, we have been working in Lawrence, Boston,

Columbus, Ohio, and the British Virgin Islands. We are seeking an environment where we have access to the expertise we need, when we need it and at a reasonable cost,” says Al Kyle, Perfusion president and CEO. “M2D2 provides access to a faculty with expertise in life sciences, animal laboratories, technical facilities and staff, and a business incubator where we will locate our administrative office. These are critical to the success of small medtech startup companies.”

Founded in 2003, Perfusion has been developing technology to deliver drugs to the brain for treatment of brain tumors, stroke and epilepsy. Most recently the company has been operating in Lawrence. It is relocating to Wannalancit on UML East.

“Perfusion is an ideal candidate for M2D2, and we are delighted to have them as a tenant,” says Paul Wormser, entrepreneur-in-residence and associate director of external funding, technology transfer and partnering. The Commercial Ventures and Intellectual Property office is collaborating with



▲ Prof. Stephen McCarthy, co-director of the Massachusetts Medical Device Development Center (M2D2)

M2D2 to help it get established. “The company is filing a National Institutes of Health grant to combine its technology with our nanosphere technology,” says Wormser. “That is exactly the kind of collaboration with our talented faculty that we encourage and can facilitate.”

The Perfusion device combines ultrasound with IV-administered therapeutics. The combined therapy overcomes the “blood-brain barrier” that

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## Campus Attracting More and Better Incoming Students

### Mid-Way Projection for Quantity and Quality is Promising

**T**he goal is to increase quantity without sacrificing quality, which has risen steadily over the last few years. The result to date: increases in both quantity and quality. That’s the short version of the status report on recruiting efforts for fall ‘06.

After many years of asking the Office of Undergraduate Admissions to maintain the size of the incoming fall freshman and transfer population, Chancellor William T. Hogan charged the office this year with increasing the size of the incoming class by 10 percent. The chancellor is seeking an overall increase in student population of 20 percent, a move made possible by the campus’s improved use of space. [See the eNews story on the Master Plan.]

As of early April, the population of students who have paid an admissions deposit—generally viewed as a serious commitment to enroll—has increased by 10 percent compared to the same time last year. Freshmen are up by 3 percent and transfers are up by an amazing 74 percent. Completed applications for fall ‘06 rose 15 percent overall this year.

At the same time, the average high school grade point average (GPA) among freshman deposit-payers has risen from 3.14 in 2005 to 3.23, and the combined (verbal and math) Scholastic Aptitude Test (SAT) average has risen from 1094 in 2005 to 1096. Although these numbers will continue to fluctuate until the official count is conducted by the Office of Institutional Research in September, they correspond to the steady increase in student quality the campus has experienced over the last several years.

Tom Taylor, dean of enrollment and student success, notes that the numbers are certain to change. “We’re only about half-way through the admissions cycle right now. It doesn’t end until the date in late September when the official count is conducted by the office of Institutional Research. Every UML-related experience accepted students have between now and then can affect individual decisions and be reflected in the numbers.”

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## IN OTHER NEWS

**2006 UML Commencement** — UML announces the 2006 Commencement speaker and honorary degree recipients.

**Physics Nobel Laureate Speaks** —Roy Glauber, 2005 Nobel laureate, delivers his Nobel Lecture on light quanta

**Exploratory Program Helps Students Plan** —Incoming undeclared liberal arts majors will benefit from the Exploratory Students Program (ESP) launched by the Office of Enrollment and Student Success.

To see these and other stories, go to UMass Lowell’s new online eNews Web site at [www.uml.edu/enews](http://www.uml.edu/enews)



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## DARPA Funds Bold Research on Limb Regeneration

derived factors can compel mammalian cells to express the genes promoting limb regeneration, at the right time and in the right order.

Coordinating the consortium's effort is Stephen Badylak, D.V.M., M.D., Ph.D., research professor of surgery at the University of Pittsburgh School of Medicine and director of the Center for Pre-clinical Tissue Engineering. The consortium includes other senior investigators with diverse, yet complementary, research interests. They include two leading salamander researchers, Dr. Hans-Georg Simon from Northwestern University and Dr. Shannon Odelberg from the University of Utah, a specialist in stem cells and retinoids from Cornell Medical School, Dr. Lorraine Gudas, and an immunologist from The Wistar Institute, Dr. Ellen Heber-Katz, who has studied a "super-healer" mouse called MRL.

Some cells in adult humans, such as liver cells, are capable of self-renewal; and embryonic stem cells can form many diverse tissues, if provided with the right signals. But humans usually respond to injury with scar tissue, while salamanders instead form a blastema, containing a large pool of progenitor cells that will specialize and grow to form the bone, muscle, cartilage, nerves and skin of the regenerated limb.

The team will begin with intense study of salamanders and the super-healer mouse, MRL, to develop a comprehensive understanding of the mechanisms and processes—to obtain a blueprint—for regenerative growth. The team will then attempt to orchestrate the formation of a blastema in a non-healing mouse, where scar tissue would normally form.

DARPA demands high levels of accountability and an aggressive schedule—continued funding is contingent on six-month milestones, a fact the UML group appreciates.

Marx says, "It's exciting to be involved with research that moves beyond the cautious, incremental approach." Marx will analyze all the data from the consortium researchers to identify the molecular signature of regeneration. "Thousands of genes are expressed simultaneously; we'll be looking for markers and their temporal order of expression. We have unique



▲ The UML lab team, clockwise from left front: Anita Arun, Prof. Susan Brauhut, Vikram Shankar, Matt Belmonte, Dr. Ekaterina Vorotnikova, Soumya Vemuri and Donna McIntosh; not pictured, Doanh Mai and Rachel Mendes.

software to work with—a tribute to my bioinformatics expertise and Marx's prior work with Prof. Georges Grinstein (UML professor of computer science and director of the Bioinformatics Program)."

"Our goal is to discover what's really required to change the molecular path from developing scar tissue (in response to injury) to developing a functional limb," says Brauhut. "For example, we'll be looking at how cells are affected by the extracellular matrix and investigate how cells make the matrix. Then, using mouse embryonic stem cells or adult progenitor cells, we'll investigate how the matrix guides these stem cells to construct the appropriate three-dimensional limb structure. Once that is understood, we'll see how to stimulate adult circulating progenitor cells to form a blastema."

The UML researchers are particularly grateful to Rep. Marty Meehan and his efforts to help Louise Griffin, vice chancellor for administration and finance, bring DARPA Director Dr. Anthony Tether to campus a few years ago. His visit led to other DARPA-funded research for the UML team and the opportunity

to interact with leading researchers in all specialties concerned with wound healing.

The interdisciplinary consortium is one of only two funded for the project, out of more than 100 applications. Much of the work here on campus will be in Brauhut's new lab, outfitted with three cell culture rooms, new equipment and laminar flow hoods and a clean room. The working group includes three staff people and nine students, including one graduate student and four undergraduate biology majors, three from the honors program on campus.

—SS



▲ Kenneth Marx

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## First Company Joins Mass Medical Device Development Center

prevents toxins—and nearly all medications—from entering the brain. Drug delivery to the brain is a huge unmet need for millions of people with neurological diseases and disorders. The company has made significant progress proving that its proprietary technique works in animals.

Kyle says the method represents a huge breakthrough in medicine. He and partner Ulrich Herken, MD, Ph.D, chief science officer and founder of Perfusion Technology, conducted two studies at

Massachusetts General Hospital, and have nearly completed a third at Ohio State University. This spring they will conduct a fourth study, and filing a grant for a fifth with UML investigators.

"There are many patients with later-stage cancer who cannot benefit from the new cancer drugs because of the blood-brain barrier. We hope to develop the enabling technology that will allow physicians to help them," says Herken.

—RC

## Feasibility Study Presented to Lowell Tech Board

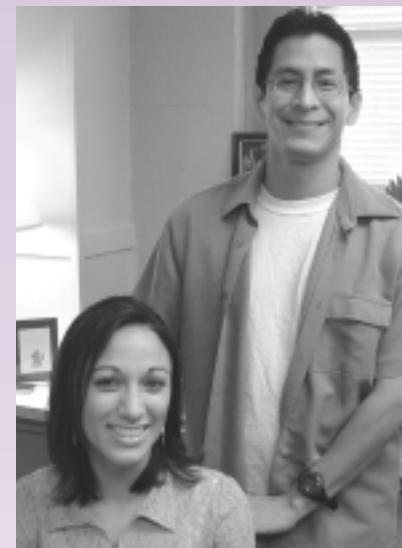
### Student Service-Learning Project Leads to Grant Proposal

Two students in the graduate Energy Engineering Program are putting their knowledge to work at the Greater Lowell Technical High School—and helping the school make use of state funds to install an educational renewable energy system.

Tanya Martinez and Jorge Barrientos developed a formal study and site analysis to propose a solar photovoltaic system as an alternative energy source for the school. They made a presentation to the March meeting of the school committee that was broadcast on local cable; based on the students' proposal, the committee voted to apply to the Renewable Energy Trust Fund administered by the Massachusetts Technology Collaborative. The proposal will fall under the Large Onsite Renewable Initiative of the fund.

Greater Lowell Tech has a renewable energy committee that is spearheading the initiative for alternative energy. Still, convincing the administration was "our biggest challenge," says Martinez. "Although the available grant makes the financial situation more attractive, the school must come up with the upfront costs for the system and it is a substantial investment for any school."

Martinez and Barrientos think the most important aspect of the project is the educational opportunity for the school. Says Barrientos, "The students can interact with the system, tracking temperature, solar irradiance, energy generated and an estimate of the carbon dioxide load reduction."



▲ Tanya Martinez and Jorge Barrientos

Based on their analysis, the students recommended installation locations for photovoltaic (PV) panels: a pitched roof location that faces south and a building-integrated PV system that acts as shades above the windows. They also suggested incorporating light shelves—indoor shelves below high windows that reflect light to the ceiling and reduce glare.

The students both graduate in December. Martinez hopes to gain green building experience, then apply that knowledge with the Mi'k Maq Nation in New Brunswick. Barrientos is looking for company experience before returning to his home in Peru.

John Duffy, professor of mechanical engineering, directs the Energy Engineering Program and leads the Service-Learning grant project in the College of Engineering. David Turcotte, program manager in the Center for Family, Work and Community, helped set up the research project in the school.



# UML Listed as One of America's Best Value Colleges

*Campus Listed Among Colleges Offering Great Education at Relatively Low Cost*

The University of Massachusetts Lowell is one of 150 public and private colleges included in the 2007 edition of "America's Best Value Colleges," produced annually by The Princeton Review (PR).

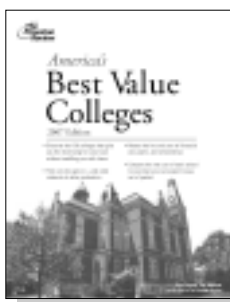
Based on data PR obtained from administrators at 646 colleges and surveys it conducted of students attending them, the new 2007 edition recommends 103 public and 47 private colleges in 40 states.

According to Robert Franek, vice president of publishing at PR, "We use more than 30 factors to rate the colleges in five categories: academics, tuition, price minus average amount students receive in gift aid scholarships and grants, financial aid (how well colleges meet students' financial need) and student borrowing."

In addition to generic features like "Paying for College 101," the book contains a three-page profile on each college. Profiles include advice on getting into the

school and obtaining financial aid, a review of career and employment patterns among the school's graduates, a report on the average out-of-pocket costs students or their parents pay for the degree, stats on the average debt load of graduating seniors, first-hand comments from students and interesting extras like the school's mascot and most popular majors.

According to promotional materials, "America's Best Value Colleges" is intended to be used as a guide to families searching for a college bargain, defined by PR as "offering excellent academics, generous financial aid packages and relatively low costs." The book was first published in 2004.



## Stecchi Awards 1st Annual Scholarship

Former dean of the School of Health and Environment Jan Stecchi, center, celebrates with the recipients of her First Annual Janice M. Stecchi Scholarship. Kristin Palladino, left, and Doreen Duquette were chosen based on their academic excellence and desire to be actively involved in health care.

## The Slavers Are Busy Again

*Center for Women and Work's Forum Takes on Human Trafficking*

Many Americans think that slavery here ended in the 19th century. At the Center for Women and Work's eighth annual "Gathering at the Well," participants learned that slavery—in the form of human trafficking—continues today, both in the U.S. and abroad.

Defined by Center researchers as "modern-day slavery and a byproduct of our global economy," human trafficking takes the form of forced industrial or agricultural work, marriage, domestic servitude, organ donation, or sexual exploitation. It is fostered by connections made over the Internet and fueled by poverty. Keynote speaker Professor Emerita Jean L. Pyle, senior associate for the Center, spoke to about 70 gathered in Alumni Lydon Library about international trafficking, while speakers Carol Gomez, director of Trafficking Victims Outreach and Services Network, and Harvard graduate student Kyla Mitsunaga, head of her own student anti-trafficking group, focused on the regional problem.

Gomez said that she has handled a several dozen cases over the past two years and spoke about individual cases. Mitsunaga discussed taking action to stop trafficking.

"We really do have a lot of work to do on the international level, the state level and

the local level," said Pyle. Participants broke into small groups following the speaking program and came up with ideas on how to fight trafficking.

"We thought this was over, but the slavers are busy again," participants read, from a poem penned for the occasion by Charles Levenstein, professor emeritus of Work Environment. Then, they broke chains of key rings in a symbolic gesture of breaking the chains of modern-day slavery.

The event was funded in part by the UMass Lowell Council for Diversity and Pluralism, the Psychology Graduate Student Association and UML Council of Federated Centers and Institutes.



Speakers on human trafficking include, from left, Carol Gomez, director of Trafficking Victims Outreach and Services Network, Harvard graduate student Kyla Mitsunaga, head of a student anti-trafficking group, and Prof. Emerita Jean Pyle. They spoke to an audience of about 70 at the Center for Women and Work's eighth annual Gathering at the Well forum.

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## Campus Attracting More and Better Incoming Students

Comparing the number of prepaid students to last year, the Division of Sciences has a 13 percent increase, the College of Engineering has increased 15 percent, the School of Health and Environment is up 19 percent and the College of Management has increased 16 percent. All four experienced significant jumps in the numbers of completed applications received.

The Division of Humanities, Social Sciences and Fine Arts has remained stable, with a 14 percent increase in applications and a 1 percent increase in paid deposits.

"At this time, the transfer numbers are high compared to previous years," cautions Assoc. Vice Chancellor Joyce Gibson. "This number will come down over the next couple of months. The number will still be greater than last year due to adding a new staff member and more strategic recruiting, as well as a stronger interest by transfer students in our programs."

Kerri Mead and Michael Belcher, interim co-directors of Admissions, think the increases can be attributed, in part, to the University's reputation.

For the full story go to [www.uml.edu/enews](http://www.uml.edu/enews)



Members of the Undergraduate Admissions team include, from left, Dean of Enrollment and Student Success Tom Taylor, Gerald Durkin, director of transfer admissions and Associate Vice Chancellor Joyce Gibson. Michael Belcher, interim co-director of admissions, is seated in center.

## See eNews

([www.uml.edu/eNews](http://www.uml.edu/eNews)) for a related story on the new Exploratory Student Program, a retention effort targeted to incoming undeclared liberal arts students.

## University Introduces Public Health Laboratory Scientist Graduate Certificate

*Program Helps Meet Nationwide Critical Shortage*

To help satisfy a critical need for qualified public health laboratory scientists, the Department of Clinical Laboratory and Nutritional Sciences is establishing a graduate certificate course in that area.

The program will begin his fall with an estimated five to 10 students, growing to an average of 10 to 12 new students per year in the second year. Larger classes are anticipated when the program eventually goes online, according to Prof. Kay Doyle, chair of the department.

"This is the first program of its kind in the country and perhaps in the world," she says.

Concerns about bioterrorist attacks post 9/11, the threat of disease epidemics from natural disasters such as Hurricane Katrina, and worries about pandemics such as avian flu require trained public health laboratory personnel. But there is a documented shortage of these professionals in Massachusetts and throughout the nation.

"In these times of natural disasters and biological and chemical terrorism, it's essential that we have clinical lab scientists who understand the public health network and services," Doyle says.

But the average number of clinical lab science/medical technology graduates is only about 5,000 a year while the projected need is more than double that number. In addition, 72 percent of board certified medical laboratory personnel are 40 years old or older, with the average age being 47.

A study published in 2004 found that 29 states, including Massachusetts, "do not have adequate numbers of laboratory scientists to manage tests for anthrax or the plague if there were to be a suspected outbreak."

The University's certificate program is designed for laboratory professionals and public health informatics specialists or administrators now working in or with experience in a public health career or related science field.

The certificate curriculum will consist of a core course and three electives. The core course will instruct students in the fundamentals of public health philosophy and structure, and in the role of the public health laboratory network in meeting public health objectives.

"The state Department of Public Health has been extremely cooperative in helping us design this program," Doyle says. "They took the lead in developing the required course, and several members of the department will be guest lecturers."



▲ Kay Doyle



# New Faculty Researcher Works on Nonlinear Systems

*Hu Aims to Control Physical Qualities in Our Lives*

**T**ingshu Hu, assistant professor of electrical and computer engineering, has traveled far to become part of the UMass Lowell community—from Shanghai, where she studied and worked for 16 years, to Hong Kong, to Canada, to the University of Virginia for a Ph.D. degree and to the University of California Santa Barbara for a post-doctoral position.

Now she teaches a second-year undergraduate course in electrical circuits and advanced courses in control systems, her specialty.

“Control systems are used everywhere, from refrigerators to airplanes to spacecraft,” explains Hu. “These are decision-making systems—you have an objective and use information and measurement from sensors to adjust actuation automatically via controllers to meet the objective.”

Cruise control in an automobile is an example of a simple control system,

whereas an airplane is much more complex because of the many degrees of freedom and demanding requirements.

Hu’s research involves developing theory and numerical tools to optimize the performance of nonlinear control systems: those that present complex computational challenges. Following up on her doctoral research at UVA, she is working on a project to

develop an artificial heart pump that is magnetically suspended within the vessel.

“The tolerances are only one quarter millimeter,” says Hu, “and the rotor must be kept adjusted for different rates of flow.” Magnetic fields are nonlinear—change in strength is not proportional to change in distance.



▲ Tingshu Hu

Hu is participating in a joint proposal with UVA researchers to the National Science Foundation and is planning to build a small experiment here to mimic the dynamics. The project has also received attention and sponsorship from a number of companies.

# Therrien Strives To Perfect a System for Detecting Bacteria

*Existing Methods Lack Either Speed or Sensitivity*

**T**here are two basic methods of detecting the presence of bacteria, according to Asst. Prof. Joel Therrien. One, he says, is very sensitive but too slow. The other is very fast but not sensitive enough.

Therrien, who joined the Electrical and Computer Engineering Department last fall, is conducting research to perfect a biosensor that will be both fast and sensitive. Such a sensor would have applications in many areas, but especially in medicine and national defense.

And way, way out in the future, Therrien’s biosensor—which, he says, could be as small as a box of Tic Tacs—might be used by shoppers to check cuts of meat in the supermarket to make sure they are free of bacteria.

One method for detecting bacteria in medical practice today involves the collection of samples that are then grown in a Petri dish for 12 to 24 hours. Meanwhile, the patients in question must be treated on the assumption that they are, in fact, infected with the bacteria.

The second method entails testing for airborne bacteria, such as anthrax. This process, in which the air passes through equipment about the size of a shoebox, is fast but not extremely sensitive.

“The goal,” says Therrien, “is to develop something that is highly sensitive but that can do the job in real time.”

He’s researching a system that involves measuring the vibrating frequency of nano-sized cantilevers (think diving boards). Bacteria have properties that cause them to stick to specific proteins in the body. Therrien would coat his cantilevers with proteins that

would capture and indicate the presence of various types of bacteria.

The trick is to be able to detect vibrations on the infinitesimally small cantilever.

“The smaller the cantilever, the more sensitive it is,” he says. “My technique is to use a method called Tunnel Gap Modulation Spectroscopy that I developed while doing post-doc-

toral work at Purdue University.”

The objective is to make this system small enough and inexpensive enough to be practical. To accomplish this, Therrien’s idea is to mount nano-tube cantilever sensors on chips that will be able to detect different kinds of bacteria.

“Ideally, these chips would cost only a few dollars apiece and would be contained in something as small as a Tic Tac box,” he says.



▲ Joel Therrien

# Crugnola Endows Scholarship for Graduating Engineers

*Complete Engineer Grant Will Support RESD Studies*

**M**ore than ever, citizens of the world need to understand both technology and society to make well-informed decisions. Now, thanks to an endowed scholarship established by Plastics Engineering Prof. Aldo Crugnola, former dean of engineering, graduating engineers will have the opportunity to broaden their education.

“An engineer can do more than work with things,” says Crugnola, who joined the engineering faculty in 1968, and was dean from 1977 to 1996. “Many of our students have gone on to other professions, such as medicine and law. My idea is to provide some financial support to a graduating engineer to carry out, in a broad sense, something to do with people.”

The new scholarship will be available for graduate study in the Department of Regional Economic and Social Development (RESO), and could expand as master’s degree programs become available at UML in other humanities and social sciences.

Crugnola’s interest in well-rounded education is long standing: as dean, he collaborated with Peter Blewett, dean of the College of Liberal Arts, to establish a “cluster” course requirement in engineering. These were

courses that met the general education requirement, but developed around a theme or discipline; faculty from the liberal arts participated. He says, “Technological education needs to be broader as our graduates aspire to more fully offer their education to society and become leaders. And engineers add something of value in return, with a particularly well-organized way of thinking and a disciplined approach.”

The Department of Regional Economic and Social Development is the newest on campus; it is multidisciplinary, drawing on the fields of economics, history, political science, psychology, sociology and urban planning. Through its two-year master’s program, RESO prepares graduates to analyze the development and sustainability of regions—their economic vitality, social cohesion and environmental

stewardship—and intervene to improve conditions.

The scholarship is an outright grant, with no teaching or work requirement, and \$5,000 will be available to one student beginning in fall, 2006. Students are also eligible to apply for Research Assistant support and for other funding sources available to RESO graduate students. Application requirements are available from

Assoc. Prof. Sarah Kuhn, at ext. 2903, Sarah\_Kuhn@uml.edu. More information on the Department of Regional Economic and Social Development can be found on the departmental website or the main office on the fifth floor of O’Leary Library.



▲ Aldo Crugnola

# UML Campus Transformation Project

**T**he International Exchange and Collaboration Team seeks to broaden the experience of students and faculty. To read the whole story go to [www.Uml.edu/enews](http://www.Uml.edu/enews) for the next installment in a series on the Transformation teams’ efforts..

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